

Webbings for Use in Elevated Oxygen Environments

Flammability test results for commercial-off-the-shelf webbings that meet NASA flammability requirements are reported for use in elevated oxygen environments anticipated for future lunar and Martian missions. Testing demonstrated that a webbing composed of 60% Kevlar®/40% polybenzimidazole (PBI) from Sturges Manufacturing Company, Inc., specifically the natural version, passed flammability testing per NASA-STD-6001B Test 1 using a surface ignition in J-configuration at 37% oxygen and 8.2 psia. Offgassing data are also provided for the natural webbing, which is gold colored. These findings support their potential use as suitable webbings for softgoods applications, although final performance and wear characteristics must be validated in full configuration.

Background

An elevated oxygen environment is planned for future crewed missions to the Moon and Mars to reduce the prebreathe time before extravehicular activities. In this study, materials are being evaluated for use at 37% oxygen and 8.2 psia. An enriched oxygen environment increases the flammability risk and the need for improved fire-resistant materials. The NASA Engineering and Safety Center (NESC) developed a strategy to ensure textile materials that meet NASA flammability requirements in this environment are available to the aerospace community as the building blocks to softgoods flight hardware. The strategy is being implemented by the Mars Campaign Office and Johnson Space Center with support from the NESC. The first phase is testing commercial-off-the-shelf (COTS) textiles with high potential to meet flammability requirements.

Problem/Issue Description

Narrow woven fabrics, commonly referred to as webbing or woven tape, are used in multiple softgood applications, including crew mobility aids, restraint nets, and storage bag handles. The standard meta-aramid or nylon webbings do not meet the flammability requirements in elevated oxygen.

Test Methods/Data Collection

NASA-STD-6001B Test 1 was performed on the webbing candidates at White Sands Test Facility (WSTF) to determine the maximum oxygen concentration (MOC) at a pressure of 8.2 psia. The test was performed in an unshielded J configuration, where the cut edge of the webbing was not exposed to the flame and the igniter impinged on the front surface of the material, which included the lateral free edge of the webbing. Flammability performance

after wear and tear was not assessed. The MOC test refers to the maximum oxygen concentration at which a minimum of five samples tested pass the NASA-STD-6001B criteria at a fixed pressure. One-inch-width natural and black webbings, composed of 60% Kevlar and 40% PBI produced by Sturges Manufacturing (see Figure 1), were tested. The available webbing widths range from ¼ to 8 inches.

Analysis and Results

Table 1 summarizes the webbing properties and test results. The webbings had MOCs of 37% and 35% oxygen for the natural and black webbing, respectively, at 8.2 psia. In addition, offgas testing was performed on natural webbing per NASA-STD-6001B Test 7. Detailed test results can be found in MAPTIS links listed in the reference section.

Part Number	X-7591 (34563)	X-7590
Colors	Natural	Black
Material Composition*	60% Kevlar/40% PBI	
Width (per FED.STD.191A Method 5020)*	1 inch	
Thickness (per FED.STD.191A Method 5030)*	0.064 +/- 0.006 inch	
Weight (per FED.STD.191A Method 5041)*	0.75 oz/yard	
Tensile (per FED.STD.191A Method 4108)*	800 lb minimum	
MOC at 8.2 psia (per NASA-STD-6001 Test 1)	37% oxygen	35% oxygen
Offgassing (per NASA-STD-6001, Test 7)	394 lb in a 15-m³ volume	Untested

* Vendor-supplied data.

These results should be used to select materials for incorporation into a final softgood product. The final flammability result will depend on the other components of the end item and must be tested in configuration to ensure the final product meets requirements. Individual textile results do not guarantee the performance of the finished assembly. Variations on this webbing (i.e., including but not limited to dimensions, weave type and yarn size, density, treatments, color, fiber blend, edge finish technique, the addition of features like hook and loop fasteners, and wear and tear) may affect flammability characteristics and should be evaluated before use.

References

1. Black color webbing: Flammability Report WSTF 26-49145, <https://maptis.ndc.nasa.gov/matsel/app/material/73441?sender=global-search>
2. Natural color webbing: Flammability and Offgassing Report WSTF 26-49149, <https://maptis.ndc.nasa.gov/matsel/app/material/73442?sender=global-search>
3. HEO-DM-1006 Updated Exploration Atmospheres
4. Manufacturer website: <https://www.sturgesmfgco.com/>
5. Manufacturer contact: Mike Allen (mallen@sturgesmfgco.com 315-880-0937)
6. NASA-STD-6001B Flammability, Offgassing, and Compatibility Requirements and Test Procedures

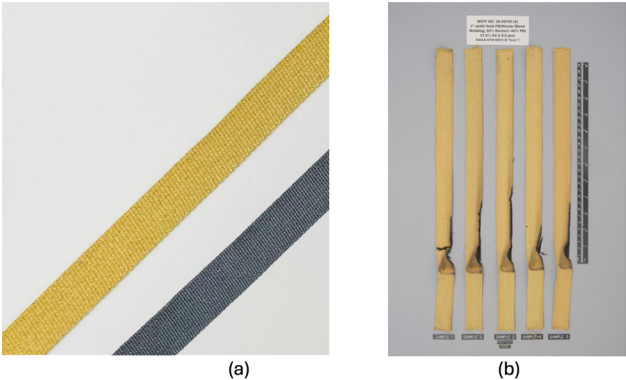


Figure 1. (a) Natural and black Kevlar/PBI 1-inch-wide webbings manufactured by Sturges Manufacturing Co., Inc. [Photo Credit: Sturges Manufacturing], and (b) Post flammability test photo of natural webbing [Photo Credit: WSTF]

NESC tech bulletin